OPEN ACCESS

Impact of the transition to digital pathology in a clinical setting on histopathologists in training: experiences and perceived challenges within a UK training region

Lisa Browning ,[1,2] Lucinda Winter,[2] Rosalin A Cooper ,[3] Abhisek Ghosh,[2,4] Thomas Dytor,[2] Richard Colling,[2,5] Eve Fryer,[2] Jens Rittscher,[1,6,7] Clare Verrill [1,2,5]

► Additional supplemental material is published online only. To view, please visit the journal online (http://dx.doi.org/10.1136/jcp-2022-208416).

[1]NIHR Oxford Biomedical Research Centre, Oxford, UK
[2]Cellular Pathology, Oxford University Hospitals NHS Foundation Trust, Oxford, UK
[3]Cellular Pathology, Wycombe Hospital, High Wycombe, UK
[4]Nuffield Department of Clinical Laboratory Sciences, University of Oxford, Oxford, UK
[5]Nuffield Department of Surgical Sciences, University of Oxford, Oxford, UK
[6]Department of Engineering Science, University of Oxford, Oxford, UK
[7]Big Data Institute, University of Oxford, Oxford, UK

Correspondence to
Dr Lisa Browning, Cellular Pathology, Oxford University Hospitals NHS Foundation Trust, Oxford OX3 9DU, UK; Lisa.Browning@OUH.nhs.uk

Received 24 May 2022
Accepted 8 July 2022
Published Online First 29 July 2022

To cite: Browning L, Winter L, Cooper RA, *et al*. *J Clin Pathol* 2023;**76**:712–718.

ABSTRACT

Aims With increasing utility of digital pathology (DP), it is important to consider the experiences of histopathologists in training, particularly in view of the varied access to DP across a training region and the consequent need to remain competent in reporting on glass slides (GS), which is also relevant for the Fellowship of the Royal College of Pathologists part 2 examination. Understanding the impact of DP on training is limited but could aid development of guidance to support the transition. We sought to investigate the perceptions of histopathologists in training around the introduction of DP for clinical diagnosis within a training region, and the potential training benefits and challenges.

Methods An anonymous online survey was circulated to 24 histopathologists in training within a UK training region, including a hospital which has been fully digitised since summer 2020.

Results 19 of 24 histopathologists in training responded (79%). The results indicate that DP offers many benefits to training, including ease of access to cases to enhance individual learning and teaching in general. Utilisation of DP for diagnosis appears variable; almost half of the (10 of 19) respondents with DP experience using it only for ancillary purposes such as measurements, reporting varying levels of confidence in using DP clinically. For those yet to undergo the transition, there was a perceived anxiety regarding digital reporting despite experience with DP in other contexts.

Conclusions The survey evidences the need for provision of training and support for histopathologists in training during the transition to DP, and for consideration of their need to maintain competence and confidence with GS reporting.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ While there is an understanding of the need for guidance for histopathologists transitioning to reporting clinical cases with digital pathology, guidance specifically to address the needs of histopathologists in training is not well established.

WHAT THIS STUDY ADDS

⇒ Assessment of the experiences of histopathologists in training within a region with access to digital pathology provides new understanding of their perceptions of the benefits and challenges of adoption of digital pathology and their specific training needs.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ The survey results highlight the need to consider histopathologists in training during the transition to digital pathology, and to ensure a means to develop their confidence in its utility within the diagnostic setting. We outline key considerations for training in digital pathology and the potential support needed for those working within training regions with variable access to digital pathology.

INTRODUCTION

Adoption of digital pathology (DP) within clinical practice is in the early stages in the UK. There are currently few centres with a fully digital set-up for diagnostic reporting; however, other centres are beginning the transition. The benefits (perceived and actual) and the challenges for diagnostic pathology practice are well documented;[1 2] however, there are limited data about the acceptance and the impact of DP on histopathology training. As one of the first UK centres to undertake the transition to diagnostic DP,[3] we previously explored the considerations necessary for histopathologists in training (hereafter 'trainees') in relation to this, and what measures might be beneficial in support of their specific training needs,[4] proposing a programme of training with a theoretical and practical introduction ahead of DP transformation.

As the transition to DP continues to evolve nationally and internationally, there is now comprehensive literature on DP validation for diagnostic reporting[5 6] and increasing numbers of experiential commentaries on DP implementation,[2 7–12] with national and international groups being established to support the pathology community in the transition, and onward to the development and use of artificial intelligence (AI).[13–16] However, similar support for trainees is lacking.

Uniquely, we have been able to reflect on the trainees' experience of the introduction of diagnostic DP to our region. Through an online survey, we have explored their opinions regarding the

transition to diagnostic digital reporting, and the wider potential benefits of DP to training and education, and any perceived challenges that access to DP introduces.

METHODS

A survey was circulated via the online SurveyMonkey survey tool (www.surveymonkey.com) to 24 trainees in their first year of training and above, based in four regional hospitals: the index tertiary referral centre which has been fully digitised since summer 2020[3] and three district general hospitals, one of which is currently partially digitised and the others without a digital diagnostic service.

The survey results would be used to inform training in DP within the region, and through better understanding of the reported perceptions and opinions, potentially improve the success of both DP training and utilisation.

The survey comprised 33 individual questions (online supplemental file), about demographics, personal experience of DP within a clinical diagnostic setting, wider experience of DP for education and in other settings, current level of access to diagnostic DP, perceived training needs in relation to the transition to DP, impact of DP on histopathology training and examinations, and for those without current DP experience in a clinical setting there were questions on perceived readiness for transition, and areas of perceived potential benefit and challenge in the use of DP in the diagnostic setting. There were also questions on attitudes and opinions to both DP and AI in histopathology. The trainees were asked to consider their responses in relation to DP experience in the absence of the impact of COVID-19, as far as possible.

RESULTS

Nineteen trainees responded to the survey (79% response rate) and all answered in full. Respondents were at varying stages in their training, with 11 of 19 in the first 3 years of training, and 8 of 19 in their 4th year or above. In relation to examination status (Fellowship of the Royal College of Pathologists, FRCPath), 5 of 19 were post-FRCPath part 2 (all five with experience of diagnostic DP), with the remainder pre-FRCPath part 2 (9 of 19 pre-FRCPath part 1).

General level of experience of DP

Eleven of 19 trainees reported that they had worked in a centre with access to DP for diagnosis, although only 10 of 19 had personal experience in using DP for diagnosis, of whom 9 of 19 had >6 months of DP experience. One respondent with DP experience for diagnosis in one hospital (>6 months) had since moved to a new post in a hospital without current access to DP.

A minority (3 of 19) had exposure to DP during undergraduate medical education in histology or histopathology.

All respondents had experience of DP in at least one context (figure 1), and the majority (17 of 19) had used online digital slide resources for their own education or in the context of a course, and over half (11 of 19) had used DP slides for educating others.

Ninety per cent (9 of 10)using DP for diagnosis were aware of the Royal College of Pathologists (RCPath) guidance on the implementation of digital pathology;[17] however, only 33% (3 of 9) working outside the department using DP were aware of this guidance.

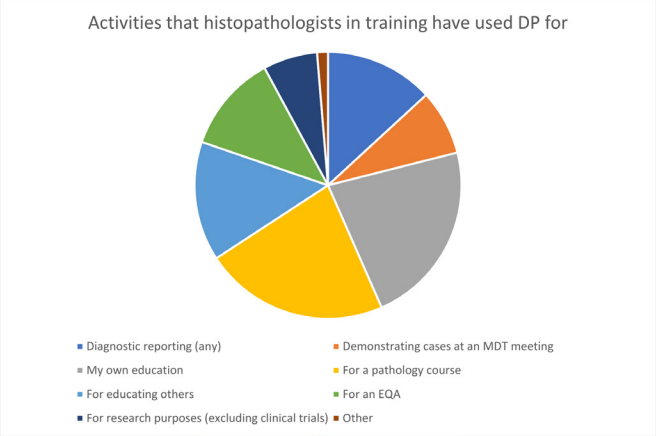

Figure 1 Activities that histopathologists in training have used digital pathology (DP) for to date. EQA, external quality assurance scheme; MDT, multidisciplinary team.

Training to use DP in the diagnostic setting

Seven of 19 reported having not received any specific training in the use of DP for diagnosis, including 20% of those currently using DP for diagnosis. Almost half had attended a training day on DP (8 of 19), and 3 of 19 had received training from the DP vendor (including 30% of those currently using DP). Validation sets collated in-house for consultant pathologists undergoing DP validation had been reviewed by 2 of 19 respondents, both with experience of diagnostic reporting on DP. No respondents had undertaken a formal 'validation' process.

Experience with DP in the diagnostic setting

All trainees who have been based in the centre with routine diagnostic DP had experience in reporting surgical pathology digitally (10 of 19), and in the use of DP for sharing diagnostic cases flagged by colleagues for educational purposes. The extent to which these trainees currently use DP for diagnostic work is variable; 4 of 10 (3 of whom are post-FRCPath part 2) report using DP only for specific aspects of diagnostic reporting, such as assessment of measurements (tumour, margins), and prefer to report on glass slides (GS). The remaining 6 of 10 review both digital slides and GS for each case, with 4 of 6 reviewing *all* GS for a case (as opposed to review of selected GS). None report solely on DP. In terms of confidence in DP reporting, 6 of 10 do not feel confident but believe that they will do with additional experience. Of those who were more confident, the time taken to gain confidence was very variable (<1–>6 months).

Specific considerations related to diagnostic DP experience and perceived differences between DP and GS reporting are presented in table 1.

An essential part of training is the opportunity to review diagnostic cases with an experienced colleague, typically the consultant pathologist responsible for sign-out of the diagnostic report. DP introduces additional considerations around this, which have been impacted further by the COVID-19 pandemic and the requirement for social distancing and remote working. In our institution, there has been an overlap between the introduction of DP and the safe working requirements of the pandemic which are difficult to disentangle. However, pandemic aside, trainees reporting diagnostic cases on DP have various options for reviewing cases with a consultant colleague:

- DP together in real time in the same location.
- DP together in real time but remotely via videoconferencing.

Table 1 General opinions of histopathologists in training in relation to reporting diagnostic cases on digital images versus GS

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree
I am confident in making diagnoses on DP (generally)	0/10	2/10	2/10	5/10	1/10
I do not feel that DP for clinical diagnosis is different to diagnosis on GS	0/10	3/10	6/10	1/10	0/10
I find reporting on DP more difficult (generally) than on GS	1/10	3/10	3/10	3/10	0/10
It takes me longer to review diagnostic cases digitally compared with glass (in general)	0/10	4/10	2/10	1/10	3/10
When reporting a case, I usually review the digital slides in preference to the GS	0/10	7/10	1/10	2/10	0/10
I prefer reporting digitally to reporting on GS	1/10	6/10	2/10	1/10	0/10
I am concerned about the accuracy of reporting on digital images vs GS	0/10	3/10	3/10	4/10	0/10
I have awareness of recognised areas of potential pitfall in diagnosis on DP in general	0/10	0/10	1/10	8/10	1/10
I find that reviewing cases on the diagnostic digital platform (IMS) is superior in terms of ability to make a diagnosis, to reviewing a similar case on a non-diagnostic platform (ie, for educational use)	0/10	1/10	2/10	4/10	2/10

DP, digital pathology; GS, glass slides; IMS, information management system.

- Review of cases separately with email communication about the findings.
- Trainee review of case on DP but then on GS in real time with the consultant.

Respondents did not express a preference as to which of these case sharing options was most beneficial to training. Six of 10 agreed that it made no difference whether the case was co-reviewed on GS or digitally, although case sharing limited to email communication was least favoured.

Trainees were asked to comment (free text) on areas they found to be easier with DP and those they felt to be more challenging (table 2).

Training to report diagnostic cases on a digital platform

Those trainees using DP for diagnostic reporting were asked about training in relation to this. While they generally felt supported in the transition to DP, 4 of 10 felt that they had not received sufficient training to report digitally (with 4 of 10 neutral on this point). Only 1 of 10 felt that specific training was not necessary in relation to making the transition. Four of 10 were concerned about maintaining competence in reporting on GS.

The following specific areas were agreed as being of interest for future training, in order of popularity: potential challenges/pitfalls in digital diagnosis, data governance and ethical considerations, use of digital platform (functionality), integration of DP into the laboratory workflow and information technology considerations.

General considerations around the wider impact of access to diagnostic DP on training experience

For those within the DP-enabled centre, all agreed it had been a positive experience, facilitating generally improved case sharing and access to cases (see figure 2). None felt that the introduction of DP had negatively impacted their training.

Free-text comments included:

- 'Reduction of pressure on trainees who can keep slides but consultant can review digital images and order extra work in parallel.'
- '…overall the introduction of DP is positive in that it makes a huge number of cases accessible and reviewable to trainees, however DP and the option for more remote working has meant that I feel I had less contact with consultants and time going through cases.'

In relation to readiness for the FRCPath examinations, it is noteworthy that no respondents felt that using DP for diagnosis would impact examination preparation negatively, although 1 of 19 felt that the largely digital nature of cases shared for teaching sessions in region might have a negative impact. Overall, DP was seen to facilitate access to a greater range and numbers of cases

Table 2 Areas identified by histopathologists in training as a potential challenge with the digital platform and areas which may potentially be made easier

Areas of potential challenge with the digital platform	
Diagnostic considerations	Lack of nuclear detail (4 comments) Assessing mitotic count (2 comments) Depth of focus/3D assessment (2 comments) Fear of missing something, including small details (2 comments) Time taken to assess the digital slides (2 comments) Grading of tumour Identifying microorganisms Refractile material
Technical considerations	Image lagging Out-of-focus images Reproduction of colours Digital system failure Waiting for slides to be scanned
Areas that may potentially be easier with the digital platform	
Diagnostic considerations	Making measurements (9 comments) Low power view including megablocks (6 comments) Comparing slides (eg, H&E with immunohistochemistry, 3 comments) Easier to ensure all of the slide is seen Easier to visualise the whole case that is for review Identification of lymphovascular invasion Assessment of small gastrointestinal biopsies, polyps, appendix, gall bladders
Workflow considerations	Sharing of cases with colleagues Recall of slides for a prior related case
Patient care-centred considerations	Reduces risk of misplacing or breaking slides
Teaching/training related	Annotating images to share with colleagues and at MDT meetings (6 comments)

3D, three-dimensional; MDT, multidisciplinary team.

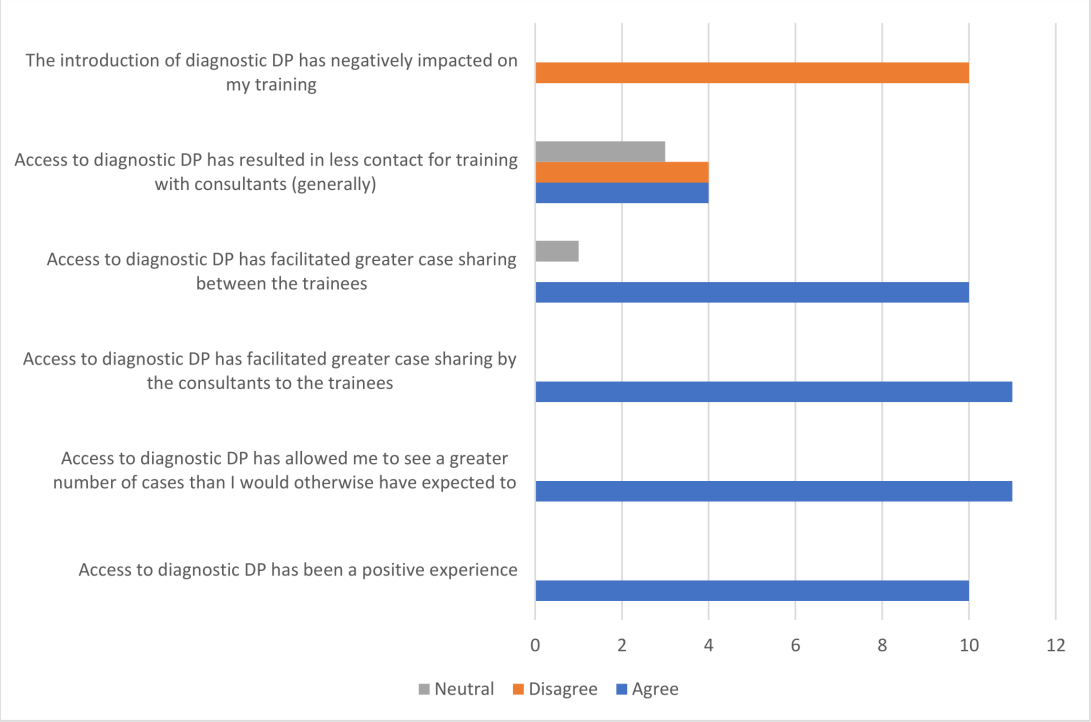

Figure 2 Opinions of histopathologists in training around the wider impact on training experience of the access to diagnostic DP (in the digitally enabled centre). Note that 11 respondents have answered some questions (additional respondent without diagnostic DP experience). DP, digital pathology.

than otherwise might be expected, with 12 of 19 and 13 of 19 agreeing this to be the case, respectively (the remainder being neutral or unsure).

Given the nature of the FRCPath part 2 examination, a case-based practical assessment set on GS, we focused specifically on any perceived potential impact of DP on the examination preparation. Five of 19 have undertaken the FRCPath part 2 since DP was introduced within region, and the opinions of these trainees were split:

- One of five felt that reporting and reviewing cases regularly on DP (vs GS) has an impact (negative) on readiness for the examination.
- Two of five (three of five neutral) preferred to report on GS during examination preparation.
  - Mixed view as to whether it would have been more helpful to review cases on GS with a consultant during this time.

While there was no preference as to whether teaching cases were more helpfully seen on GS versus DP in the examination preparation period, three of five and two of five agreed that practice examinations and FRCPath part 2 courses (respectively) were better on GS versus DP (the remainder being neutral). Subjectively, the respondents regarded access to DP (including remotely) as having made examination preparation easier overall.

Free-text comments in relation to DP and the examinations included:

> The issue for FRCPath examinations is there is a tendency to neglect exam practice cases on glass especially for cytology.
> Whilst it is better to see cases on glass slides in preparation for the exam, being able to have regular black box sessions and access to essentially a 'library' of cases digitally is much more time-efficient. This benefit completely outweighs the cost of seeing 'less' glass to a degree.
>
> ….I would not be happy to sit a digital Part 2 examination without formal training and significant clinical experience with DP.

Perceptions of trainees in non-DP-enabled training centres within region

While this had been explored to an extent in our previous work,[4] the current survey provides a novel insight specifically as to how *variable* access within the region may itself impact on perceptions in contrast to investigation of perceptions of a DP-naïve cohort. The results are presented in table 3.

It is evident from these results that this cohort of trainees feels that access to DP anywhere within region has a positive impact on their training overall (including five of six in non-digital centres), although there are clear concerns about the variable access to diagnostic DP within region and to their own transition to DP reporting.

Notably, one respondent had moved from a centre with access to DP and experience with digital reporting to one without access. This doctor suggested that the transition could be challenging, in view of changes in workflow and access to cases, and the loss of benefits of DP such as ease of measurements and low power assessment, although overall did not perceive negative impact on training.

Perception of the impact of availability of DP on training and future job prospects, and on the promise of AI

Overall, there was positivity in relation to the impact on training of the introduction of DP into the region, with 84% (16 of 19) agreeing that this has been a positive experience, and 89% (17 of 19) agreeing that it has provided greater training opportunities. Considering impact on their future consultant careers, 95% (18 of 19) agree that the ability to report on both DP and GS will be beneficial, and 74% (14 of 19) agree that personal experience

Table 3 Perceptions of histopathologists in training working in non-digital centres of the impact of variability of DP access within region

	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Don't know	N/A
I am concerned that the variability in access to DP for diagnosis across training centres will impact negatively on my training overall	0/19	1/19	0/19	5/19	2/19	0/19	11/19
I do not consider the variability in access to DP across training centres to be an issue in relation to my training experience in histopathology	1/19	6/19	1/19	0/19	0/19	0/19	11/19
I feel that access to DP within any centre within the training region has had a positive impact on my training overall	0/19	0/19	0/19	3/19	2/19	1/19	13/19
I feel that DP is overhyped	1/19	4/19	0/19	3/19	0/19	0/19	11/19
I am apprehensive about the transition to DP in my own practice when this is available to me	1/19	1/19	2/19	1/19	3/19	0/19	11/19
I look forward to being able to report diagnostic cases on a digital platform	0/19	0/19	1/19	3/19	0/19	4/19	11/19
I do not feel that reporting diagnostic cases on a digital platform will be any different to reporting on glass slides	1/19	6/19	0/19	1/19	0/19	0/19	11/19

DP, digital pathology; N/A, not applicable.

with diagnostic DP during training will impact on future job choices (more likely to apply for jobs with access to DP).

Finally, while the survey has not focused on AI, there was good awareness of the potential role for AI in pathology, with almost all respondents having awareness of the potential for AI to aid diagnosis, prognostication and derivation of novel insights into disease. Seventy-four per cent (14 of 19) look forward to the potential of using AI, although around one-third (7 of 19) remain concerned about the potential for DP and AI to replace pathologists. Thirty-seven per cent (7 of 19) have already had involvement in research in the development of AI, and overall, 79% (15 of 19) would like to be involved.

DISCUSSION

The literature on the transition to the use of DP for diagnostics is extensive; however, training and guidance specifically related to histopathologists in training are rarely mentioned, and the opinions and perceptions of those in training to the transition to DP are largely unknown.

In contrast to the governance structures in place for consultant histopathologists in terms of developing and ensuring competence in diagnostic reporting on whole slide images, including RCPath guidance on a formal validation process to reporting digitally,[17] and guidance from the College of American Pathologists,[18] there is currently no such equivalent for trainees nor recommendation within these documents as to how they might be considered during DP implementation, although awareness exists that such guidance is warranted.[19] The movement of doctors between centres during training with variation in availability of DP requires additional consideration around the maintenance of skill and confidence (and competence) in reporting GS, an observation relevant not just in the UK.[12] Furthermore, the FRCPath part 2 examination is on a GS rather than digital format which has the potential to introduce anxiety among those preparing for the examination who may feel 'out of practice' with making diagnoses on GS, especially given that many organised courses now use digitised slides, in part driven by the need for remote delivery of teaching during the COVID-19 pandemic.

The results of our survey have been enlightening in that while the trainees overall perceive a large amount of educational benefit in relation to access to DP, particularly during the COVID-19 pandemic, as highlighted by others,[20–22] there is evidence of variability in the uptake of DP in the diagnostic setting, and a perceived lack of confidence in its routine use.

The reason for the perceived reluctance to fully use DP for diagnostic reporting is not entirely clear from the survey. The respondents showed good awareness of the potential pitfalls in digital diagnosis, in line with those previously reported within the literature,[23] and generally felt that they had sufficient training to use the digital platform. But levels of confidence in reporting digitally were not uniformly high and only 3 of 10 trainees with diagnostic DP experience were 'not concerned' about the accuracy of reporting on DP versus GS. While those using DP diagnostically were aware of the RCPath guidance on validation, a minority had reviewed any of the available validation sets, which is a core component of the governance structures recommended at consultant level during the transition to DP. It could be inferred that the lack of a 'validation-type' exercise may have impacted on confidence in digital reporting and a willingness to use the system routinely, confounded by a degree of concern (shown by 4 of 10) about maintaining competence in reporting on GS. Indeed, personal communication with trainees subsequent to the survey indicates enthusiasm for a 'validation' process to aide confidence in their diagnostic interpretation on DP, and suggests that the motivation to transition to DP is impacted by wider issues around the need to maintain skills in GS reporting both during training and for future job opportunities at consultant level. It was also highlighted that making the transition to DP during the later stages of training when focus is necessarily on developing confidence in independent reporting is potentially an additional challenge. Consideration of the stage of training at which DP is accessed for diagnostic reporting is therefore also important, although clearly this will be less of an issue when DP is more widely available.

Significantly, the skill to report on GS is required for the FRCPath part 2 examination; however, within our cohort, it appears that transitioning to DP ahead of the examination was not a significant concern as the perceived benefits of rapid access to larger numbers of cases digitally outweighed the reduction in reporting on GS, although there were mixed opinions as to whether having formal teaching and practice examinations during this period in a GS format might be more beneficial. It should be noted for context locally that while DP reporting has been adopted widely within the digitally enabled department,

the GS are routinely sent out to the pathologists, and therefore any impact from more limited access to GS for diagnostic cases may not be reflected fully in the current survey.

Maintenance of competence in GS reporting also remains relevant due to the rotational nature of the training programme, given that some centres are currently without access to DP, a situation not unique to our region; and this must be a consideration for training going forward. We would advocate that therefore trainees must be supported to ensure that they feel confident of the return to GS reporting and given the time to make the adjustments.

It was noteworthy that those without current diagnostic DP experience conveyed considerable anxiety about the transition, although it is evident that they have significant DP experience within other contexts such as educational courses. This is important to address, as while positive emphasis on the relevance of *any* DP experience in developing confidence about digital diagnostic reporting may be reassuring, it is noted that 60% (6 of 10) of our cohort accessing DP regarded the clinical standard platform as superior for diagnostic purposes to platforms used purely in the educational setting. This may be a significant consideration if it translates that suboptimal experience with DP within an educational setting negatively impacts confidence in DP.

Going forward, we would advocate a multilayered approach to training within a region with access to diagnostic DP, recognising the overlap with the needs of consultant colleagues but also the specific considerations for training which we have outlined. General education early on in relation to the utility of DP, on practical issues related to integration of DP into the laboratory, and governance-related matters including the validation process, will provide inclusivity across a region with variable access, and can take the form of a group session effectively establishing a 'community of practice'. Training on technical considerations would be beneficial at the outset to ensure understanding of the functionality of DP and what the limitations may be. Our trainees expressed interest in the ethical and legal considerations in relation to DP, and these needs should be addressed more widely as recent evidence has revealed a general lack of understanding among histopathologists of these aspects.[24] There should be provision of training on the use of the digital platform, with ongoing support for issues arising. Importantly, we would advocate establishment of a DP validation resource generalised across specialties, enabling trainees to develop confidence in DP reporting. Awareness of existing educational resources developed by early adopters of DP, including those developed by the PathLAKE consortium in the UK (www.pathlake.org), should also be raised. Finally, we recognise that some trainees would benefit from additional support during the transition, and on the basis of the survey results, we have proposed a mentorship scheme whereby trainees with DP experience offer support to others in transition; a scheme that could be rolled out more widely beyond the region as other centres become digitally enabled, and this is to be explored.

CONCLUSION

To date, the needs of histopathologists in training as they transition to DP have not been evaluated specifically, and while many of these needs overlap with those of consultant pathologists, there remain specific considerations which are particularly relevant within training regions with variable DP access. We have shown that confidence in reporting on the digital platform is a major factor for consideration, and while there is no formal recommendation for trainees to undergo validation to report digitally, this may be of benefit in aiding successful transition. At this stage where DP is not uniformly available, support is also necessary to maintain skills with GS reporting.

Handling editor Runjan Chetty.

Acknowledgements Thanks to the histopathologists in training in the Thames Valley region for completing the survey.

Contributors LB conceived the survey, reviewed the survey responses and drafted the manuscript. LW, RAC, AG, TD, RC and CV reviewed and contributed to the survey questions and assisted in the review of the responses. All authors reviewed, contributed to and agreed the final draft of the manuscript. LB acts as guarantor for this work and the conduct of the study.

Funding An accelerated Access Collaborative/NHSX AI in Health and Care Award. The NHSX Artificial Intelligence in Health and Care Award: Driving system-wide improvements with real-world economics evidence and subspecialist-led adoption guidelines for full workflow implementation of AI with Paige Prostate cancer detection, grading and quantification tool in histopathology departments (AI_AWARD02269). RC and LB are also supported by this award.An accelerated Access Collaborative/NHSX AI in Health and Care Award. The NHSX Artificial Intelligence in Health and Care Award: Driving system-wide improvements with real-world economics evidence and subspecialist-led adoption guidelines for full workflow implementation of AI with Paige Prostate cancer detection, grading and quantification tool in histopathology departments (AI_AWARD02269). RC and LB are also supported by this award.An accelerated Access Collaborative/NHSX AI in Health and Care Award. The NHSX Artificial Intelligence in Health and Care Award: Driving system-wide improvements with real-world economics evidence and subspecialist-led adoption guidelines for full workflow implementation of AI with Paige Prostate cancer detection, grading and quantification tool in histopathology departments (AI_AWARD02269). RC and LB are also supported by this award. An accelerated Access Collaborative/NHSX AI in Health and Care Award. The NHSX Artificial Intelligence in Health and Care Award: Driving system-wide improvements with real-world economics evidence and subspecialist-led adoption guidelines for full workflow implementation of AI with Paige Prostate cancer detection, grading and quantification tool in histopathology departments (AI_AWARD02269). RC and LB are also supported by this award.An accelerated Access Collaborative/NHSX AI in Health and Care Award. The NHSX Artificial Intelligence in Health and Care Award: Driving system-wide improvements with real-world economics evidence and subspecialist-led adoption guidelines for full workflow implementation of AI with Paige Prostate cancer detection, grading and quantification tool in histopathology departments (AI_AWARD02269). RC and LB are also supported by this award.

Disclaimer Views expressed are those of the authors and not necessarily those of the PathLAKE consortium members, the NHS, Innovate UK, UKRI, the NIHR, the Department of Health, NHSX or the Department of Health and Social Care.

Competing interests None declared.

Patient consent for publication Not required.

Ethics approval The survey was conducted anonymously as a service evaluation exercise, and it was highlighted that the results would potentially be used within peer-reviewed publications/presentations.

Provenance and peer review Not commissioned; internally peer reviewed.

Data availability statement Data sharing not applicable as no datasets generated and/or analysed for this study.

ORCID iDs
Lisa Browning http://orcid.org/0000-0003-4254-333X
Rosalin A Cooper http://orcid.org/0000-0002-8548-1178
Clare Verrill http://orcid.org/0000-0002-4905-8233

REFERENCES

1 Griffin J, Treanor D. Digital pathology in clinical use: where are we now and what is holding us back? *Histopathology* 2017;70:134–45.
2 Hanna MG, Ardon O, Reuter VE, *et al*. Integrating digital pathology into clinical practice. *Mod Pathol* 2022;35:152–64.
3 Colling R, Protheroe A, Sullivan M, *et al*. Digital pathology transformation in a supraregional germ cell tumour network. *Diagnostics* 2021;11:2191.
4 Browning L, Colling R, Rittscher J, *et al*. Implementation of digital pathology into diagnostic practice: perceptions and opinions of histopathology trainees and implications for training. *J Clin Pathol* 2020;73:223–7.
5 Hanna MG, Reuter VE, Hameed MR, *et al*. Whole slide imaging equivalency and efficiency study: experience at a large academic center. *Mod Pathol* 2019;32:916–28.
6 Azam AS, Miligy IM, Kimani PK-U, *et al*. Diagnostic concordance and discordance in digital pathology: a systematic review and meta-analysis. *J Clin Pathol* 2021;74:448–55.
7 Retamero JA, Aneiros-Fernandez J, Del Moral RG. Complete digital pathology for routine histopathology diagnosis in a multicenter Hospital network. *Arch Pathol Lab Med* 2020;144:221–8.
8 Thorstenson S, Molin J, Lundström C. Implementation of large-scale routine diagnostics using whole slide imaging in Sweden: digital pathology experiences 2006-2013. *J Pathol Inform* 2014;5:14.
9 Cheng CL, Azhar R, Sng SHA, *et al*. Enabling digital pathology in the diagnostic setting: navigating through the implementation journey in an academic medical centre. *J Clin Pathol* 2016;69:784–92.
10 Evans AJ, Salama ME, Henricks WH, *et al*. Implementation of whole slide imaging for clinical purposes: issues to consider from the perspective of early Adopters. *Arch Pathol Lab Med* 2017;141:944–59.
11 Stathonikos N, Nguyen TQ, Spoto CP, *et al*. Being fully digital: perspective of a Dutch academic pathology laboratory. *Histopathology* 2019;75:621–35.
12 Stathonikos N, Nguyen TQ, van Diest PJ. Rocky road to digital diagnostics: implementation issues and exhilarating experiences. *J Clin Pathol* 2021;74:415–20.
13 Colling R, Pitman H, Oien K, *et al*. Artificial intelligence in digital pathology: a roadmap to routine use in clinical practice. *J Pathol* 2019;249:143–50.
14 Rakha EA, Toss M, Shiino S, *et al*. Current and future applications of artificial intelligence in pathology: a clinical perspective. *J Clin Pathol* 2021;74:409–14.
15 Fraggetta F, L'Imperio V, Ameisen D, *et al*. Best practice recommendations for the implementation of a digital pathology workflow in the anatomic pathology laboratory by the European Society of digital and integrative pathology (ESDIP). *Diagnostics* 2021;11:2167.
16 Eloy C, Bychkov A, Pantanowitz L, *et al*. DPA-ESDIP-JSDP Task force for worldwide adoption of digital pathology. *J Pathol Inform* 2021;12:51.
17 Royal College of Pathologists. Best practice recommendations for implementing digital pathology. London Royal College of Pathologists; 2018. https://www.rcpath.org/uploads/assets/f465d1b3-797b-4297-b7fedc00b4d77e51/best-practice-recommendations-for-implementing-digital-pathology.pdf [Accessed 5 Apr 2022].
18 Pantanowitz L, Sinard JH, Henricks WH, *et al*. Validating whole slide imaging for diagnostic purposes in pathology: guideline from the College of American pathologists pathology and laboratory quality center. *Arch Pathol Lab Med* 2013;137:1710–22.
19 The Royal College of Pathologists. RCPath digital pathology strategy, 2019. Available: https://www.rcpath.org/uploads/assets/2248bb71-b773-4693-945bffda593f2f2f/cf251e84-f7d0-415d-bb67217219203066/Digital-Pathology-Strategy.pdf [Accessed 4 May 2022].
20 Roy SF, Cecchini MJ. Implementing a structured digital-based online pathology curriculum for trainees at the time of COVID-19. *J Clin Pathol* 2020;73:444.
21 Cho WC, Gill P, Aung PP, *et al*. The utility of digital pathology in improving the diagnostic skills of pathology trainees in commonly encountered pigmented cutaneous lesions during the COVID-19 pandemic: a single academic institution experience. *Ann Diagn Pathol* 2021;54:151807.
22 Lujan GM, Savage J, Shana'ah A, *et al*. Digital pathology initiatives and experience of a large academic institution during the coronavirus disease 2019 (COVID-19) pandemic. *Arch Pathol Lab Med* 2021;145:1051–61.
23 Williams BJ, DaCosta P, Goacher E, *et al*. A systematic analysis of discordant diagnoses in digital pathology compared with light microscopy. *Arch Pathol Lab Med* 2017;141:1712–8.
24 Coulter C, McKay F, Hallowell N, *et al*. Understanding the ethical and legal considerations of digital pathology. *J Pathol Clin Res* 2022;8:101–15.

Survey of histopathology trainees to assess the impact of the availability of digital pathology for clinical diagnosis within a training region

We are interested in understanding the experiences to date of the histopathology trainees within Thames Valley in relation to the use of digital pathology for diagnostic purposes, and in gauging the opinions of trainees generally on digital pathology and artificial intelligence in our specialty.

We are aware that the experience will be varied across the region and there are questions to explore both the impact of the availability of digital pathology for those who have worked in a centre using digital pathology (Oxford), and for those in centres where digital pathology is not yet available on site. We wish to capture the opinions and experiences across the trainees **in all centres** in region.

The results will be reviewed to identify any areas that could be improved upon, and equally any points of good practice that can be shared more widely. We plan to share the results with you all in due course.

We would therefore be grateful for your time in completing this survey; the survey responses collated will be anonymous.

The results may be used in future peer-reviewed publications and / or presentations.

Thank you in advance for your time.

Questions 1-6: General demographics

Please provide the following details about yourself;

1. Are you a histopathology trainee?

Yes

No (please specify)

2. What is your current level of training?

(please select one of the following options)

ST1

ST2

ST3

ST4

ST5

ST5+

Other (please specify)

3. Which level of the FRCPath examinations are you currently at?

(please select one of the following options)

Pre-FRCPath part 1

Pre-FRCPath part 2 (but post-FRCPath part 1)

Post-FRCPath part 2

Other (please specify)

4. Which of the following best describes your current post?

(please select one of the following options)

Histopathology specialty trainee

Neuropathology specialty trainee

Paediatric pathology specialty trainee

Academic Clinical Fellow (ACF)

Clinical Lecturer / Post-Doc

Non-training post (training level)

Other (please specify)

5. Which of the following best describes your current place of work?

(please select one of the following options)

General hospital

Tertiary/specialist referral centre

Tertiary/specialist referral centre with a research active pathology department

Out of programme currently

Other (please specify)

6. Considering your undergraduate medical education, did you have any experience with digital pathology (virtual microscopy) for histology or histopathology?

(please select all that apply)

No

Yes – images being presented by lecturers on a virtual microscope

Yes – opportunity to use a virtual microscope myself

Yes – other (please specify)

Questions 7-22: General considerations around current level of experience with digital pathology;

7. Have you to date worked in a centre with access to digital pathology for diagnostic reporting?

(please select one of the following options)

No

Yes – I **currently** work in a centre using digital pathology for diagnostic practice (I have < 6 months DP experience)

Yes – I **currently** work in a centre using digital pathology for diagnostic practice (I have > 6 months DP experience)

Yes – **not currently** but I previously worked in a centre using digital pathology for diagnostic practice (I have < 6 months DP experience)

Yes – **not currently** but I previously worked in a centre using digital pathology for diagnostic practice (I have > 6 months DP experience)

8. Which of the following best describes the set-up in your current place of work

(please select one of the following options)

We do not have access to digital pathology

We have a scanner for digitisation of slides but we do not use it at all

We have a scanner for digitisation of slides but it is used for purposes other than diagnostic work (e.g. education, research)

We routinely digitise **some** of our diagnostic slides for digital reporting (but glass slides still routinely sent out to pathologists)

We routinely digitise **all** of our diagnostic slides (histology) for digital reporting (but glass slides still routinely sent out to pathologists)

We routinely digitise our diagnostic slides and do not send out the glass slides routinely from the lab

9. Which of the following activities have you ever used digital pathology for to date?

(please select all that apply)

Diagnostic reporting (any)

For demonstrating cases at an MDT meeting

For my own education (online teaching slides)

For a pathology course (e.g. FRCPath preparation course, ST1 block teaching)

For educating others

For an EQA

For research purposes (excluding clinical trials)

For clinical trial purposes – central pathology review of slides

For clinical trial purposes (FFPE block selection for a trial)

Other (please specify)

None of the above

10. Which of the following best describes your current <u>diagnostic</u> practice in your post?

(please select one of the following options)

I only report using a light microscope with glass slides

I report using a light microscope with glass slides, and occasionally report via digital pathology

I report routinely using both digital pathology and glass slides in roughly equal proportions

I report predominantly using digital pathology

11. If you are <u>not reporting on digital pathology currently</u>, have you had experience of digital pathology reporting for diagnosis previously?

(please select one of the following options, and answer N/A if you are reporting digitally in your current post)

Yes – regular reporting on digital pathology (most cases)

Yes – occasional reporting on digital pathology (some cases)

No

N/A

12. Regarding training to report diagnostic histopathology cases on the digital platform; (please select all that apply)

I am aware of the RCPath guidance on the validation process for digital pathology

I have undertaken a 'validation process' for diagnostic reporting on the digital platform (**please provide details below in the comments**)

I have reviewed the 'validation' slide sets (some or all) available in my department for the consultants training in digital pathology (or prior department if you have moved job)

I have had training from the vendor (Philips, Leica etc.) on the use of the digital platform

I have attended a training day (of any sort) on digital pathology in clinical practice

I **have not** received any training in diagnostic reporting on a digital platform

Please make any suggestions below as to training that you feel is most useful to aide the transition to digital reporting, including suggestions for the future;

If you have undertaken a 'validation' exercise then please also provide details here.

Questions 13- 21: The following questions are related to your experience of reporting diagnostic cases on the digital platform;

If this does not apply to you as you have not reported any diagnostic cases digitally please answer N/A.

13. Which of the following types of diagnostic cases have you had experience in reporting on digital pathology?

(please select all that apply, and if you have not had experience in reporting diagnostic cases digitally please answer N/A)

Surgical cases (primary reporting)

Surgical referral cases (external referrals)

Educational cases flagged by a consultant / specialty doctor

Educational cases flagged by another trainee

Autopsy pathology

Other (please specify)

N/A

14. If you are reporting on digital pathology, or previously reported digitally, which of the following best describes your use of digital pathology for assessment of diagnostic cases?

(please select one of the following options, and if you have not had experience in reporting cases digitally please answer N/A)

When I report a case digitally I review the case both digitally and on glass slides (all glass slides)

When I report a case digitally I review the case both digitally and on glass slides (selected glass slides)

When I report a case digitally I only review the case digitally and do not review the glass slides (except for problematic areas such as special stains, amyloid)

I only use digital pathology for reviewing diagnostic cases to assess measurements e.g. margins, or for review for assessment of need for levels / immuno / special stains, but otherwise make my diagnoses on glass slides

Other scenario (please specify)

N/A

15. If you have had experience reporting diagnostic cases on a digital platform, how quickly do you feel that it takes to get confident in reporting digitally (in general, as there may still be cases you rather report on glass)?

(please select one of the following options, if you have not you have not had experience in reporting diagnostic cases digitally please answer N/A)

< 1 month

1-3 months

3-6 months

> 6 months

I do not feel confident reporting diagnostically on a digital platform, but feel that I will do in time

I do not feel that I will ever be entirely confident reporting diagnostic cases digitally

N/A

16. Considering your experience in reporting diagnostic cases on digital images rather than glass slides, please answer the following;

(if you have not had experience in reporting diagnostic cases digitally please answer N/A)

Strongly disagree, disagree, neutral, agree, strongly agree, don't know, N/A

I am confident in making diagnoses on digital pathology (generally)

I do not feel that digital pathology for clinical diagnosis is different to diagnosis on glass slides

I find reporting on digital pathology more difficult (generally) than on glass slides

It takes me longer to review diagnostic cases digitally compared with glass (in general)

When reporting a case I usually review the digital slides in preference to the glass slides

I prefer to report digitally than on glass slides

I am concerned about the accuracy of reporting on digital images vs glass slides

I have an awareness of recognised areas of potential pitfall in diagnosis on digital pathology in general

I find that reviewing cases on the diagnostic digital platform (IMS) is superior in terms of ability to make a diagnosis, than reviewing a similar case on a non-diagnostic platform (i.e. for educational use)

17. Considering training and the set-up to report diagnostic cases on digital images vs glass slides, please answer the following;

(if you have not had experience in reporting diagnostic cases digitally please answer N/A)

Strongly disagree, disagree, neutral, agree, strongly agree, don't know, N/A

I feel that I have had sufficient training to report on a digital platform

I **do not** feel that I needed any specific additional training to report diagnostic cases digitally

I have felt supported in the transition to digital pathology

I have an appropriate workstation set-up for digital reporting

I would like to know more about potential challenges / pitfalls in diagnosis on digital pathology

I would like additional training on the use of the digital platform (functionality)

I would like to know more about the integration of digital pathology into the laboratory workflow

I would like to know more about the IT considerations in relation to digital pathology

I would like to know more about the data governance / ethical considerations in relation to digital pathology

I am concerned about maintaining my competence in reporting cases on glass slides

Any comments

18. Can you please provide examples of any aspects of reporting diagnostic cases that are <u>easier</u> in your experience on digital images than on glass slides;

19. Can you please provide examples of any aspects of reporting diagnostic cases that are <u>more challenging</u> in your experience on digital images than on glass slides;

20. Considering your experience in reviewing clinical cases with a consultant histopathologist since the introduction of digital pathology into your workplace, how have these cases been reviewed?

(please select all that apply and if you have not had experience in reporting diagnostic cases digitally please answer N/A)

Reviewing cases on the digital platform **together in real-time** (in person)

Reviewing cases separately on the digital platform **in real-time but remotely** with discussion of the cases via a video-conferencing platform or telephone

Reviewing cases separately but with email communication about the interpretation / diagnosis and any questions

I reviewed the cases on the digital platform but the cases were reviewed together in person on glass

N/A

Other (please specify)

Any comments

21. Considering your opinion on the educational / training value when reviewing clinical cases with a consultant histopathologist, please answer the following;

(if you have not had experience in reporting diagnostic cases digitally please answer N/A)

Strongly disagree, disagree, neutral, agree, strongly agree, don't know, N/A

It is educational to review cases on the digital platform **together in real-time** (in person)

It is educational to review cases separately on the digital platform **in real-time but remotely** with discussion of the cases via a video-conferencing platform or telephone

It is educational to review cases separately but with email communication about the interpretation / diagnosis and any questions

It is educational to review cases on the digital platform but then to review the case together in person on glass

I prefer to review the cases with a consultant on the digital platform (in person or remotely)

I prefer to review the cases with a consultant on glass slides (even if I have reviewed them digitally)

I do not think it makes a difference whether the case is reviewed with the consultant on glass or on the digital platform

22. If you have <u>previously</u> had experience reporting diagnostic cases on the digital platform, but are <u>now working in a centre without</u> access to digital pathology, please answer the following;
(please select N/A if this does not apply to you)

Strongly disagree, disagree, neutral, agree, strongly agree, don't know, N/A

I have not had any problems with the change to reporting solely on glass slides from digital pathology

I do not feel that the variation in reporting (digital vs glass) is of any real significance

The transition back to reporting on glass slides has been challenging for me

I feel that I lost my confidence on reporting cases on glass slides as a result of previously reporting digitally

Recognition needs to be given to the variability in reporting format (digital vs glass) within a training region

I feel that the variation in reporting across training centres has negatively impacted on my training

Any comments

23. Please consider the following questions in relation to your training experience since the introduction of digital pathology into your workplace (please try to consider this in the absence of the impact of Covid-19);

(if you have not been based in a department with access to digital pathology please answer N/A)

Strongly disagree, disagree, neutral, agree, strongly agree, don't know, N/A

The introduction of digital pathology into the department for diagnostic use has been a positive experience

I feel that access to digital pathology in the department has allowed me to see a greater number of cases than I would have expected to in my attachments

I feel that access to digital pathology has facilitated greater case sharing **by the consultants to the trainees**

I feel that access to digital pathology has facilitated greater case sharing **between the trainees**

I feel that access to digital pathology within the department has resulted in less contact for training purposes with consultant histopathologists in general

The introduction of digital pathology into the department for diagnostic use has impacted negatively on my training

Any comments

Questions 24-26 : the following questions are focussed on digital pathology in relation to the FRCPath examinations;

24. Please consider the following in relation to the FRCPath examinations;

Strongly disagree, disagree, neutral, agree, strongly agree, don't know, N/A

The availability of digital pathology within our region provides greater opportunity to see clinical cases than I would otherwise expect to have

I feel that I have seen a **greater range** of clinical cases as a result of the availability of digital pathology within region

The utility of digital pathology in a diagnostic setting impacts negatively on preparation to take the FRCPath part 2 examination on glass slides

The utility largely of digitised cases for teaching sessions in region impacts negatively on readiness for the FRCPath examination on glass slides

25. Have you sat the FRCPath Part 2 examination since commencing digital reporting of diagnostic cases (i.e. since digital pathology has been rolled out within your centre)?

(please select N/A if this does not apply to you)

Yes

No

N/A

26. <u>If you have sat the FRCPath Part 2</u> (on glass slides), <u>and</u> have been working in a centre with access to diagnostic digital pathology during the preparation period for the exam, please answer the following;
(please select N/A if this does not apply to you)

Strongly disagree, disagree, neutral, agree, strongly agree, don't know, N/A

I **do not** feel that regularly reporting and reviewing cases on a digital platform vs glass slides has any impact on readiness for the FRCPath Part 2 examination

In preparation for the FRCPath Part 2 examination in preference I reported diagnostic cases on glass vs digital

Reviewing my diagnostic cases with a consultant pathologist on glass slides rather than digitally in the period leading up to the FRCPath Part 2 examination would be more helpful

Practice examinations for the FRCPath part 2 are more relevant on glass slides than on a digital platform in the period leading up to the FRCPath part 2 examination

Teaching sessions specifically for preparation for the FRCPath part 2 examination are better on glass slides than on a digital platform

Teaching courses (e.g. for the FRCPath part 2 examination) should utilise glass slides in preference to digital slides

I do not feel that it matters whether educational / teaching cases are on the digital platform or glass slides for the purpose of FRCPath part 2 examination preparation

I feel that access to digital pathology for diagnostic purposes within the centre I was working enabled greater opportunity for me to see cases in preparation for the FRCPath part 2 examination (than I would have had in a department reporting solely on glass slides)

I accessed historic digitised diagnostic cases in my department during the period of preparation for the FRCPath part 2 examination

I accessed historic diagnostic cases **remotely** on the digital platform for preparation for the FRCPath part 2 examination

The ability to access diagnostic cases (for exam preparation) **remotely** on the digital platform has made the exam preparation easier for me

I do not feel that access to digitised slides within my centre has had any impact on my exam preparation

Any other comments

Questions 27-30 : the following questions are related to the impact of the introduction of digital pathology into the region, and for those not currently reporting diagnostic cases digitally, your opinions in relation to digital pathology;

27. In terms of the impact of access to digital pathology within the region and your training experience, please answer the following;

Strongly disagree, disagree, neutral, agree, strongly agree, don't know

Until this survey I was not aware that digital pathology was being used within a centre(s) in my training region

I do not feel that having digital pathology installed for diagnostic use within a centre(s) in my training region has any relevance to my training experience

The introduction of digital pathology into the training region has been a positive experience

I feel that access to digital pathology within the region has provided greater teaching / training opportunities across the region

I feel that access to digital pathology has facilitated greater case sharing between the trainees within the region (beyond centre(s) with access to digital pathology)

I feel that the ability to gain experience in region in reporting cases both digitally and on glass will be of benefit to me in the future as a consultant histopathologist

I feel that personal experience with diagnostic digital pathology during training will impact on my future job choices as I am more likely to applying for a consultant post in a centre with access to digital pathology

I would like to see greater use of the digital platform in educational / training events (please provide details below)

Any comments

28. **If you are currently working in a centre <u>without</u> access to digital pathology and <u>have to date not had experience</u> in working in a centre reporting diagnostic cases on a digital platform, please answer the following;**
(please select N/A if this does not apply to you)

Strongly disagree, disagree, neutral, agree, strongly agree, don't know, N/A

I am concerned that the variability in access to digital pathology for diagnostic practice across training centres will impact negatively on my training overall

I do not consider the variability in access to digital pathology across training centres to be an issue in relation to my training experience in histopathology

I feel that access to digital pathology within any centre within the training region has had a positive impact on my training overall

I am apprehensive about the transition to digital pathology in my own practice when this is available to me

I look forward to being able to report diagnostic cases on a digital platform

I do not feel that reporting diagnostic cases on a digital platform will be any different to reporting on glass slides

I feel that digital pathology is over-hyped

29. Please provide up to 3 suggestions as to what you feel will be the most challenging aspects of your own transition from reporting cases on glass slides to reporting digitally;

30. Please provide up to 3 suggestions as to what you feel will be advantages of reporting cases digitally vs on glass slides;

Questions 31-33: finally, the following questions are related to general considerations around the use of digital pathology and artificial intelligence in relation to histopathology.

31. In relation to general considerations around the use of digital pathology, please answer the following;

Strongly disagree, disagree, neutral, agree, strongly agree, don't know

The implementation of digital pathology into diagnostic practice is a positive step for practising pathologists

I think it likely that as a consultant pathologist I will routinely be reporting cases on a digital platform

As a consultant histopathologist I would like to report my cases on a digital platform

I feel that digital pathology is over-hyped and will not last

I have no interest in digital pathology

32. Regarding the potential role for artificial intelligence (AI) in the setting of pathology and your own experience of AI in pathology, please answer the following;

Strongly disagree, disagree, neutral, agree, strongly agree, don't know

I have an awareness of the potential for AI to play a future role in routine diagnostic practice in pathology

I look forward to the potential to use AI in my own practice as a pathologist

I am aware that AI tools already exist that may aide pathologists in **making diagnoses**

I am aware that AI tools already exist that may aide pathologists in **assessing routinely reported prognostic/predictive features in clinical cases**

I believe that AI tools will be able to **derive novel insights** into disease biology and disease prediction/prognosis in the future

I believe that novel features derived by AI will be able to be used in clinical pathways in the future

I am aware that there are already examples of accredited AI tools for use in pathology

I have seen examples of AI tools being used in pathology

I have personal experience of the use of AI in pathology for diagnosis/assessment of histological features

I am interested in the use of AI in pathology

I am worried about the use of AI in pathology

I feel that the role of AI in pathology is over-hyped

I have been involved in research in the development of AI in pathology

I would like to be involved in research in the development of AI in pathology

I am concerned that digital pathology and artificial intelligence will replace pathologists

I have no interest in AI in relation to pathology

33. **If you have seen AI in action in pathology, please can you provide examples (generally what the AI did – do not need specific examples of tools, e.g. AI to count lymphocytes)**

Any further comments